NOVEMBER/DECEMBER 2025

# 23PPH33 — NUMERICAL METHODS AND COMPUTER PROGRAMMING – THEORY

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Find the root of the equation $f(x) = x^2 - 2$ using one iteration of the Bisection method in the interval [1, 2].

2. Define the Bisection method.

3. Compute the eigenvalues of the matrix : $A = \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$.

4. Find the eigenvector corresponding to the eigenvalue $\lambda = 2$ for the matrix : $A = \begin{bmatrix} 4 & 1 \\ 1 & 4 \end{bmatrix}$.

5. What is Newton's forward difference formula used for in interpolation?

6. Write the concept of curve fittings.

7. Compare the error behavior of the Trapezoidal rule with that of Simpson's rule in numerical integration.

8. Write the impact of round-off errors when using the Euler method to solve ODEs for small step sizes.

9. Use Newton-Raphson method for finding the zeros of the function $f(x) = e^x - 3x$.

10. Find the output of a program that uses the Trapezoidal rule to approximate the integral of $f(x) = x^2$ over [0, 1].

19. Find Solution using Trapezoidal rule

| $x$ | $f(x)$ |
|---|---|
| 1.4 | 4.0552 |
| 1.6 | 4.9530 |
| 1.8 | 6.0436 |
| 2.0 | 7.3891 |
| 2.2 | 9.0250 |

20. Draw a flowchart and a corresponding program to find the root of a non-linear equation using the Bisection method. Derive the stopping criteria and explain its significance in terms of accuracy.



SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) Compare the advantages and disadvantages of the Bisection method and Newton-Raphson method.

Or

(b) Find the root of the following polynomial function using the bisection method: $x^3 - x - 4 = 0$.

12. (a) Solve using the Gauss-Jordan method :

$x + 2y = 3,\ 2x + 3y = 5$

Or

(b) Use the Jacobi method to approximate the eigen values of the matrix: $A = \begin{bmatrix} 4 & 1 \\ 1 & 3 \end{bmatrix}$.

13. (a) Given the following table of values:

| x | y |
|---|---|
| 3 | 15 |
| 4 | 20 |
| 5 | 25 |
| 6 | 30 |
| 7 | 35 |

Use Newton's backward interpolation formula to estimate the value of $y$ at $x = 4.5$.

Or

(b) For the data points (1,1)(2,4), and (4,16), use Lagrange interpolation to find the polynomial and estimate the value at $x = 3$.

14. (a) Use Simpson's rule to approximate the integral of $f(x) = \sin(x)$ from $x = 0$ to $x = \pi$ with $n$ = subintervals.

Or

(b) Derive the Gauss-Legendre quadrature formula for a 2-point rule.



15. (a) Draw the flowchart for solving a nonlinear equation using the Bisection method.

Or

(b) Write a program that finds the root of a non-linear equation $f(x) = e^x - 3x$ using the Newton - Raphson method.

SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Find a real root of the equation Finding the root of $f(x) = \cos x - x$, by Newton Raphson method up to four decimal places.

17. Find the inverse of the matrix using the Gauss-Jordan method:

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \\ 5 & 6 & 0 \end{bmatrix}$$

18. Derive Newton's Forward and backward Interpolation Formula.